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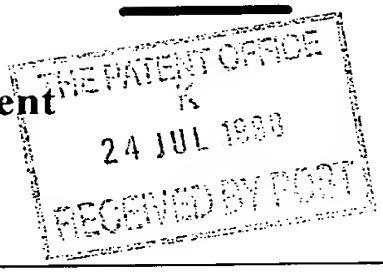
Request for grant of a patent



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1. Your reference: DJL/A9502GB

2. Patent application number *(The Patent Office will fill in this part)*: 24 JUL 1998 **9816091.4**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*:
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NE
21/8/98

Patents ADP number *(if you know it)*: 14836300 1

If the applicant is a corporate body, give the country/state of its incorporation: UNITED KINGDOM

4. Title of the invention: FURNACE LINING

5. Name of your agent *(if you have one)*: FORRESTER KETLEY & CO.

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*:
CHAMBERLAIN HOUSE
PARADISE PLACE
BIRMINGHAM B3 3HP

Patents ADP number *(if you know it)*: 133005

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day/month/year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day/month/year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer "Yes" if:*
   a) *any applicant named in part 3 is not an inventor, or*
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Claim(s)	4
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
Request for preliminary examination and search *(Patents Form 9/77)*	Yes
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent based on the basis of this application

Signature: Forrester Ketley & Co.
Forrester Ketley & Co.

Date: 23 July, 1998

12. Name and daytime telephone number of person to contact in the United Kingdom: D J Lucking — 0121 236 0484

PATENTS ACT 1977

DJL/A9502GB

Title: Furnace Lining

Description of Invention

This invention relates to a furnace lining.

By "furnace" we mean a furnace, kiln, oven or the like where there is a chamber which is heated, and into which articles are placed for heat treatment.

Furnaces tend to be dusty, particularly where there is provided a fan or high velocity burner or the like for circulating hot air within the furnace, and dust is undesirable, particularly in the case of a kiln in which ceramic articles/glazes are fired, or in an oven where vitreous enamel is baked dry. The problem of dust is aggravated where there is provided an insulating lining which is of a fibrous nature which may contain silica, which may also present a potential health hazard if the fibres become airborne.

To reduce the amount of dust contributed by the furnace lining it is common to cover the lining with a protective covering such as high-temperature resistant textile material which is attached to the lining e.g. by pins. Another approach is to cement anchors into the fibres of the insulating lining.

Yet another approach is to attach to the hot face of the lining, i.e. the face of the lining facing inwards of the furnace, ceramic plate-like members. This is used where the underlying lining requires protection from deleterious atmospheres, e.g. aggressive gases such as vanadium pentoxide which can eat away the fibrous lining material.

This latter approach provides the advantage that the ceramic plates, being generally rigid, may be used as supports for, for example, heating elements. Such ceramic plates are typically attached to the hot face with a cement material, but the adhesive effect of such cements tends to deteriorate in use with the effect that the ceramic plates separate from the insulating lining. It

will be appreciated that a falling ceramic plate can cause substantial damage to articles in the kiln, particularly where the ceramic plate is attached to the lining of a roof of the kiln, and results in damage occurring to the lining.

More expensive furnace lining materials are known such as that sold under the name "Saffil". These do not contain silica but are about 90% aluminia based fibrous insulation. Another alternative is a glass based fibre such as "Superwool".

As these do not contain silica, they are not subject to health and safety legislation controlling the use of silica based materials. Saffil is a more expensive furnace lining material than silica based materials and Superwool, and thus tends only to be used in environments where higher temperatures are experienced. Hence for economy's sake, the furnace lining has to be designed with the temperature to which the furnace is to be heated in mind, and once designed there is, conventionally, little scope for improving the thermal resistance of the lining.

According to a first aspect of the invention we provide a lining for a furnace the lining including insulating material attached to an inside wall of the furnace, the insulating material in use having a hot face which faces inwardly of the furnace, characterised in that a protective element is provided at least partially to cover the hot face, the protective element being secured relative to the hot face by means including a headed fastener, a shank of which co-operates with a member which is embedded in the insulating material.

Thus the invention may provide the advantage of a conventional furnace lining which comprises a protective ceramic plate or plates attached to the hot face of the insulating material, but the manner by which the ceramic plate is attached is more secure than a simple cement attachment.

It is envisaged that a ceramic plate type protective element may be attached by both adhesive cement and the headed fastener, so that in the event

that the cement fails, the headed fastener will prevent the protective element becoming detached from the hot face, and vice versa.

Alternatively, the advantages of non-silica containing insulating materials may be provided by attaching one or more layers of non-silica containing material, e.g. in the form of a blanket, to a conventional silica-containing lining. Thus the lining may be adapted for use in higher temperature applications by applying a layer of Saffil or the like, as the higher grade, non-silica containing material is tolerant to higher surface temperatures.

Where the lining does not require upgrading but it is desired to provide a protective element to isolate the silica containing materials, a layer of Superwool or the like may be attached.

Where it is desired to do so, a layer or layers of conventional silica-containing lining materials may be added to an existing lining structure, to upgrade the lining, although some means to protect the silica-containing lining materials from becoming airborn would be necessary to comply with health and safety legislation.

Most conveniently the shank of the headed fastener has provided thereon, a screw thread, and the embedded member includes a female threaded opening into which the threaded shank is in use screwed. Thus the fastener may be unscrewed for maintenance of the lining as and when required. However it is envisaged that the shank of the headed fastener may otherwise co-operate with the embedded member to attach the protective element at the hot face.

The shank of the threaded fastener passes through a passage of the protective element into co-operation with the embedded member. For example, the passage may comprise a pre-formed opening through the protective element or a cut-out at a side of the protective element as desired.

Of course, in the construction of the invention, the fastener will be subjected to the heat within the furnace and so preferably the fastener is made at least substantially, and preferably totally, of a ceramic material. In low

temperature environments though, the fastener could be made of, for example, nickel chrome or another suitable metal. In each case, because the fastener co-operates with the embedded member, there is no path for the conducting of heat from the fastener to the inside wall.

The protective element is preferably as light as possible and may conveniently be of plate-like configuration, made at least substantially and preferably totally, of a ceramic material. However, the protective element could comprise a blanket of silica free insulating material such as Superwool or a high-temperature resistant textile material, and/or a higher temperature resistant high alumina insulating material than the insulating material attached to the inside surface of the furnace wall.

However, the protective element could comprise additional layers of the same insulating material as that from which the remainder of the lining is made.

A furnace lining typically includes a plurality of individual blocks or modules of insulating material, each attached to the inside wall of the furnace. For example, each module may comprises a ceramic blanket which is folded to a block-like shape, with the folds extending transversely to the furnace wall.

The member with which the fastener co-operates is preferably embedded in the module, so as to extend transversely relative to the folds, during manufacture of the module.

The embedded member may be thin e.g. of generally plate like construction, and may be made substantially or totally of a ceramic material or another suitable material which is sufficiently strong to resist pull-out forces.

Whereas the protective element may comprise a single layer construction, the protective element may comprise a plurality of layers which may or may not be bonded together.

The protective element, or where the protective layer comprises single layers of e.g. ceramic, the protective element may additionally be secured relative to the hot face by adhesive cement.

According to a second aspect of the invention we provide a method of lining a furnace wall comprising the steps of attaching insulating material to the wall of the furnace, the insulating material in use having a hot face which faces inwardly of the furnace, characterised in that the method comprises embedding in the insulating material, a member which is adapted to co-operate with a shank of a headed fastener, providing a protective element at least partially to cover the hot face, securing the protective element to the hot face by inserting the shank of the headed fastener though the protective element into the insulating material, so that the shank may co-operate with the embedded member.

Preferably the shank of the headed fastener co-operates with the embedded member by rotating the shank relative to the embedded member so that a screw thread of the shank engages with a corresponding screw thread of the embedded member although other methods of co-operation may alternatively be employed.

In a typical furnace lining construction the insulating material is attached to the furnace wall by a fixing means which is operated on from the hot face of the material, using a tool which is passed through the insulating material in an opening from the hot face of the material. For example a self-drilling fastener of the fixing means may be driven into the furnace wall by being rotated using a tool which is inserted through the fibrous insulating material, thus creating an opening therethrough, and the tool is operated from the hot face of the insulating material.

Alternatively, a fastener of a fixing means or the fixing means itself may be welded to the inside furnace wall, using a welding tool which is inserted through the fibres of the lining, thus creating an opening therethrough. The method of the invention may include inserting the shank of the fastener through the opening into co-operation with the embedded member so that there is no

need to provide an additional opening to receive the shank of the headed fastener.

The furnace lining may be modular comprising a plurality of modules of insulating material, and the method may be characterised in that a substantial part of the furnace wall is covered by a plurality of protective elements each secured at the hot face of the insulating material to an individual module, by means including a headed fastener a shank of which co-operates with a member which is embedded in the insulating material.

At least where the protective element or elements are not cemented to the lining, it will be appreciated that by virtue of the protective element(s) being secured relative to the hot face by headed fastener means, the protective elements may be removed subsequently to facilitate maintenance of the lining, such as the addition of layers required to repair mechanical and/or temperature damage to the lining.

Thus according to a third aspect of the invention we provide a method of repairing a lining of a furnace made by the method of the second aspect of the invention including the steps of removing the headed fastener, removing the protective element or a layer of the protective element, and re-securing a protective element or protective element layer, to the hot face of the insulating material by means including a headed fastener a shank of which co-operates with a member which is embedded in the insulating material.

Where a furnace is lined with a lower grade insulating material and it is desired to improve either the thermal resistance of the lining or its tolerance of high temperature, this may readily be achieved either by replacing the protective element in use with a higher grade protective element where the invention is already employed, or adding one or more layers to the protective element, or to the lining below the protective element..

According to a fourth aspect of the invention we provide a method of improving the thermal resistance of an existing furnace lining having insulating

material attached to an inside wall of the furnace, the insulating material in use having a hot face which faces inwardly of the furnace and the insulating material having a member which is adapted to co-operate with a headed fastener the method being characterised in that a protective element is provided at least partially to cover the hot face, the protective element being secured relative to the hot face by means including a headed fastener, a shank of which co-operates with the member which is embedded in the insulating material.

Thus provided that an embedded member is provided in the insulating material of the lining, an existing lining may be upgraded with minimal disturbance of the lining.

The invention will now be described with reference to the accompanying drawings in which:

FIGURE 1 is an illustrative perspective view from above and to the side of part of a furnace wall lining in accordance with the invention partly broken away to reveal hidden features, and showing two alternative ways of attaching insulating material to a furnace wall;

FIGURE 2 is an illustrative view similar to figure 1 but showing an alternative embodiment, and omitting the furnace wall and showing the insulating material in a simplified manner;

FIGURE 3 is an enlarged side view showing a headed fastener of the embodiment of figure 1 in co-operation with an embedded member;

FIGURE 4 is a front view of the embedded member of figure 3;

FIGURE 5 is an illustrative view of the embodiment of figure 1 at a stage during construction, showing the insulating material simply.

Referring to figure 1 of the drawings, part of a furnace lining construction 10 is shown. Part of a furnace wall is indicated at 11, and may comprise part of the roof or a side wall of the furnace.

The furnace wall 11 may comprise a simple steel panel wall, or may be provided by a metal or other mesh. To protect the furnace wall 11 in use, from

the high temperatures within the furnace, the furnace is lined with insulating material which typically comprises a plurality of individual blocks or modules of insulating material, one of which is indicated at 12.

The thickness of the module 12 will depend on the temperatures to be generated in the furnace, and the degree of thermal resistance required to protect the furnace wall 11.

The modules 12 are typically made from a fibrous blanket of insulating material, such as an alumina/silicate based fibre, which is folded as indicated in figure 1 and compressed to shape and held by rods 18 which extend transversely to the folds, generally parallel to the furnace wall 11. The folds may be trimmed at the face remote from the furnace wall 11, to provide a substantially flat face 13 where a protective layer 26, is to be cemented to the fibres of the module 12. A fixing 14 may be embedded in the module 12 as the module 12 is made. The folds are preferably arranged to extend transversely to the furnace wall 11.

The modules 12 are attached relative to the furnace wall 11 by fixings the nature of which will depend on the module construction and the nature of the furnace wall 11.

At the right hand side of figure 1 a fixing particularly suitable for a construction where the furnace wall 11 is a steel panel is shown. The fixing 14 is attached by one or more fasteners 15 to the furnace wall 11, the fixing 14 having a hooked part 17 which is embedded in the fibres of the module 12 in a position where the fixing rod (or tube) 18 is inserted through the folds to co-operate with the hooked part 17. The rod 18 may co-operate with a plurality of fixings 14 attaching modules 12 to the inside of the furnace wall 11 but preferably and usually, each module 12 will have its own rod 18 or rods (or tubes).

At the left hand side of the figure a fixing 14a is shown which is more suited to a furnace wall 11 construction which comprises a mesh. The fixing

14a is inserted through the mesh wall 11 to a position where a hooked part 17a is engageable by a rod 18a (or tube). The fixing 14a has a transversely extending part 19 which prevents the fixing 14a passing entirely through the mesh wall 11.

Any other fixing for attaching the modules 12 to the furnace wall 11 may be employed. However, referring to figure 5, one particularly suitable fixing method, for use in conjunction with the present invention is illustrated. A fixing 14b similar to the fixing 14 of figure 1 is embedded in the module 12 during manufacture of the module 12, and is attached to the furnace wall 11 (in this case a steel panel) by one or more fasteners 15b which are operated upon from the distant inside, so called hot, face 20 of the module 12. This is achieved by passing a suitable fixing tool 21 through the material of the module 12 in the direction indicated by arrow A. Inserting the tool 21 through the material of the module 12 creates an opening 22 through the module 12 for a use hereinafter to be explained as indicated in dotted lines in figure 1. It will be noted in figure 5 that the tool 21 has to pass through a member 25 which is embedded in the module 12.

The tool 21 may be hollow so as to "core" the module 12, but due to the fibrous nature of the insulating material, when tool 21 is removed, the opening 22 will substantially closed.

Alternatively, the fixing 14b could be attached to the inside of the furnace wall by welding using a suitable tool inserted through the fibres of the module 12, or by any other desired means.

Referring again to figure 1, to provide a covering for the hot face 20 of the module 12, to deter dust circulation within the furnace and to provide physical protection for the fibrous material of the module 12, a protective element 26 is secured at the hot face 20 of the insulating lining material. In this example, the protective element 26 comprises a cordierite bat, which is a ceramic based material. Conventionally, such protective elements 26 are simply

cemented in position during manufacture of the modules 12, although may be cemented in position once the modules 12 have been attached to the furnace wall 11.

In accordance with the invention, alternatively or additionally, the protective element 26 is secured at the hot face 20 of the modules 12 by a headed fastener 27, a shank 28 of which is adapted to co-operate with the member 25 which is embedded in the material of the module 12. The fastener 27 has a head 29 which is larger than a pre-formed passage 30 through the protective element 26, whilst the shank 28 passes through the passage 30 into co-operation with the member 25. The member 25 has an opening 31 to receive the shank 28, which opening 31 is larger than the external dimension of the fixing tool 21 by which the fixing 14b was attached to the furnace wall, as described above with reference to figure 5.

Referring also now to figures 3 and 4, it can be seen that the shank 28 of the fastener 27 has a coarse male thread 35, whilst the opening 31 through the embedded member 25 has a corresponding female thread 36 so that the fastener 27 co-operates with the embedded member 25 by turning the fastener 27 with a suitable tool to engage with e.g. the head 29 of the fastener 27, and thus screwing the shank 28 of the fastener 27 into the embedded member 25.

Because the fastener 27 is in use subjected to the temperatures within the furnace, the fastener 27 is made of a suitable heat resistant material such as a ceramic based material although in a lower temperature application the fastener 27 could be made of nickel chrome or another suitable metal. The embedded member 25, although protected to some degree from the heat generated in the furnace, may also be made of ceramic or similar material, but may be made of metal or another material as desired in a lower temperature application. It will be appreciated that the embedded member 25 may be positioned at an optimum distance from the hot face 20 irrespective of the thickness of the modules 12.

The screw thread 35 of the shank 28, and the corresponding thread 36 of the embedded member 25 are preferably coarse so that only one, two or three thread pitches engage, to reduce the risk of the threads binding, whilst providing adequate resistance to the fastener 27 unscrewing as a result of vibrations experienced in use.

The embedded member 25 preferably has points 38,39 to facilitate its insertion through the folds of the material of the module 12 during construction of the module 12, but otherwise is preferably plate-like and of sufficient strength to provide a substantial resistance to pull out forces. Many alternative configurations to that shown in figure 4 are possible.

Referring back to figure 1 it will be appreciated that the thickness of the module 12 from the furnace wall 11 to the hot face 20 may vary to suit particularly furnace constructions. Because the fastener 27 engages with the embedded member 25, the position of which can be the same relative to the hot face 20 whatever the module 12 thickness, it is possible for a single length fastener 27 to be used in a wide variety of applications so that it is unnecessary to produce a range of fasteners of different length.

Various modifications are possible without departing from the scope of the invention.

For example as shown in figure 2, where similar parts to those shown in figure 1 are indicated by the same reference number, the protective element 26 does not comprise a single layer of material, but comprises a plurality of layers 26a, 26b of e.g. a silica free fibrous material, which may cover a single module 12, or a plurality of modules 12 as desired. In figure 2 the inner and outer layers 26a, 26b are attached to the insulating material of the module 12 by the fastener 27 and embedded member 25, making the replacement of the outer or both of the protective element layers 26a, 26b readily possible e.g. to replace a deteriorating layer 26b with a new layer 26b and/or to upgrade the thermal resistance of the lining by providing a higher grade layer 26b than before. Also

in figure 2, a ceramic washer 40 is shown between the head 29 of the fastener 27 and the protective element 26, which may be required depending on the nature of the outer layer 26b of the protective element 26.

If desired the invention may be employed to attach a metal protective element 26 to the insulating material of the lining, where such element is required to provide physical protection in furnaces where high velocity air impinges upon the furnace lining, which may carry sand or another hostile substance.

The protective layer 26 (or layers) could in another application comprise a simple blanket of textile material for dust suppression, or could comprise a high grade insulating material such as one of the aluminium based fibrous insulators. Thus a single protective element 26 may be provided for each module 12, or the protective element 26 or a layer of it, may span several modules 12, or more than one protective element 26 may be required for each module 12.

In another module 12 construction, instead of comprising folds, the modules 12 may be made up of cut sheets of fibrous material, or may even comprise a simple block of material as desired.

The embedded member 25 need not comprise a plate as described but could be of other configurations, such as a long spike, with a female threaded opening provided thereby.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. A lining for a furnace the lining having insulating material attached to an inside wall of the furnace, the insulating material in use having a hot face which faces inwardly of the furnace, characterised in that a protective element is provided at least partially to cover the hot face, the protective element being secured relative to the hot face by means including a headed fastener, a shank of which co-operates with a member which is embedded in the insulating material.

2. A lining according to claim 1 characterised in that the shank of the headed fastener has provided thereon, a screw thread, and the embedded member includes a female threaded opening into which the threaded shank is in use screwed.

3. A lining according to claim 1 or claim 2 characterised in that the shank of the threaded fastener passes through a passage of the protective element into co-operation with the embedded member.

4. A lining according to claim 1 or claim 2 or claim 3 characterised in that the fastener is made at least substantially of a ceramic material.

5. A lining according to any one of the preceding claims characterised in that the protective element is plate-like and is made at least substantially of a ceramic material.

6. A lining according to any one of the preceding claims characterised in that the insulating material includes a plurality of individual blocks of material, each attached to the inside wall of the furnace.

7. A lining according to claim 6 characterised in that each block comprises a ceramic blanket which is folded to a block-like shape, with the folds extending transversely to the furnace wall.

8. A lining according to claim 7 characterised in that the member with which the fastener co-operates is embedded in the block, so as to extend transversely relative to the folds, during manufacture of the block.

9. A lining according to any one of the preceding claims characterised in that the embedded member is of generally plate like construction.

10. A lining according to any one of the preceding claims characterised in that the embedded member is made substantially of a ceramic material.

11. A lining according to any one of the preceding claims characterised in that the protective element comprises a plurality of layers.

12. A lining according to any one of the preceding claims characterised in that the protective element, or where the protective layer comprises a plurality of layers at least a layer of the protective element which is closest to the hot face, is additionally secured relative to the hot face by adhesive cement.

13. A lining for a furnace substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

14. A method of lining a furnace wall comprising the steps of attaching insulating material to the wall of the furnace, the insulating material in use having a hot face which faces inwardly of the furnace, characterised in that the

method comprises embedding in the insulating material, a member which is adapted to co-operate with a shank of a headed fastener, providing a protective element at least partially to cover the hot face, securing the protective element to the hot face by inserting the shank of the headed fastener though the protective element into the insulating material, so that the shank may co-operate with the embedded member.

15. A method according to claim 14 characterised in that the shank of the headed fastener co-operates with the embedded member by rotating the shank relative to the embedded member so that a screw thread of the shank engages with a corresponding screw thread of the embedded member.

16. A method according to claim 14 or claim 15 characterised in that the insulating material is attached to the furnace wall by a fixing means which is operated on from the hot face of the material, using a tool which is passed through the insulating material in an opening from the hot face of the material, and the method includes inserting the shank of the fastener through the opening into co-operation with the embedded member.

17. A method according to claim 14 or claim 15 or claim 16 characterised in that a substantial part of the furnace wall is covered by a plurality of protective elements each secured at the hot face of the insulating material by means including a headed fastener a shank of which co-operates with a member which is embedded in the insulating material.

18. A method of lining a furnace substantially as hereinbefore described with reference to the accompanying drawings.

19. A method of repairing a lining of a furnace made by the method of any one of claims 14 to 18 comprising the steps of removing the headed fastener, replacing the protective element or a layer of the protective element, and securing a replacement protective element or protective element layer, to the hot face of the insulating material by means including a headed fastener a shank of which co-operates with a member which is embedded in the insulating material.

20. A method of improving the thermal resistance of an existing furnace lining having insulating material attached to an inside wall of the furnace, the insulating material in use having a hot face which faces inwardly of the furnace and the insulating material having a member which is adapted to co-operate with a headed fastener the method being characterised in that a protective element is provided at least partially to cover the hot face, the protective element being secured relative to the hot face by means including a headed fastener, a shank of which co-operates with the member which is embedded in the insulating material.

21. Any novel feature of novel combination of features disclosed herein and/or as shown in the accompanying drawings.

ABSTRACT

Title: Furnace Lining

A lining for a furnace includes insulating material attached to an inside wall (11) of the furnace, the insulating material in use having a hot face (20) which faces inwardly of the furnace, characterised in that a protective element (26) is provided at least partially to cover the hot face (20), the protective element (26) being secured relative to the hot face (20) by means including a headed fastener (27), a shank (28) of which co-operates with a member (25) which is embedded in the insulating material.

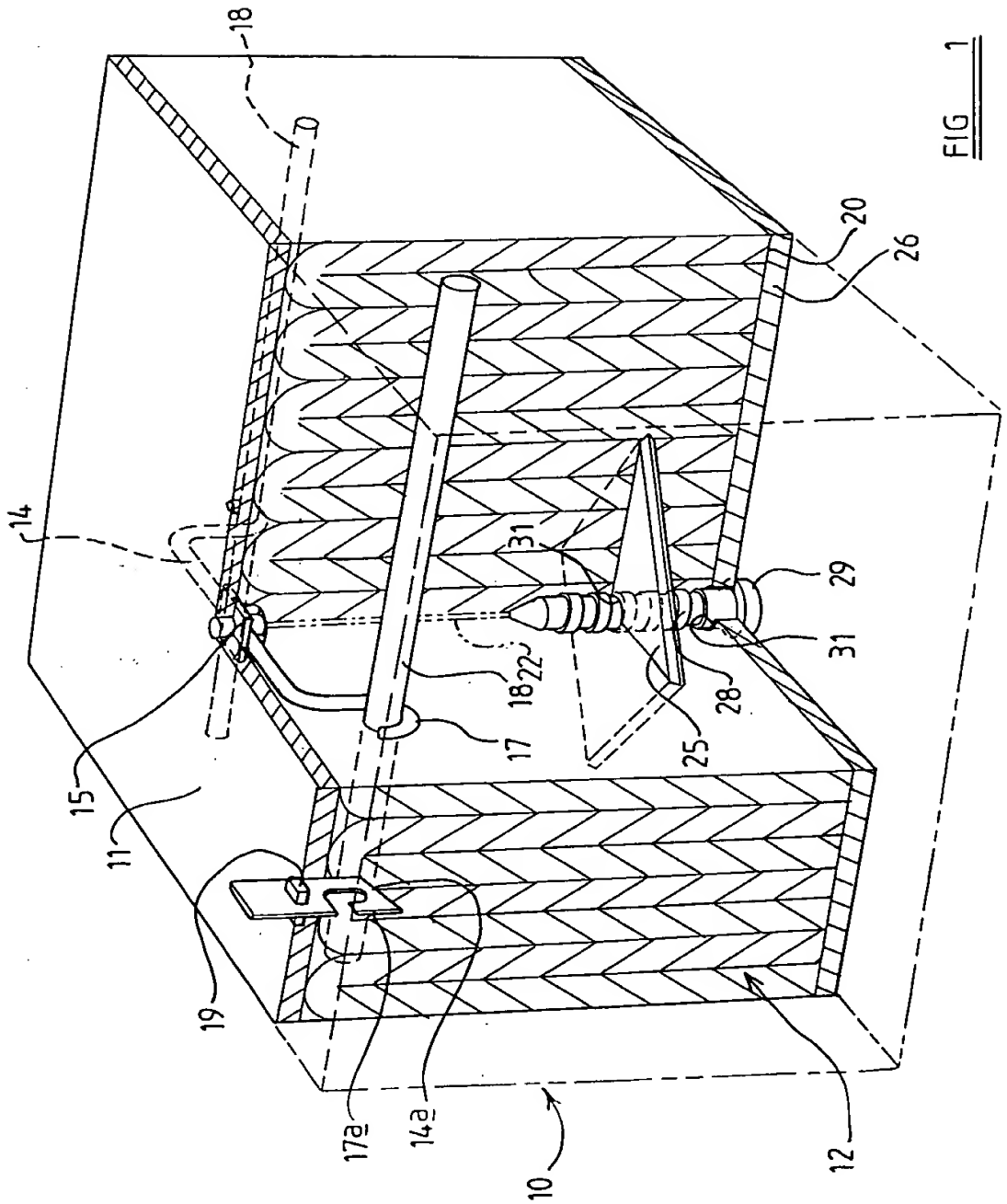


FIG 1

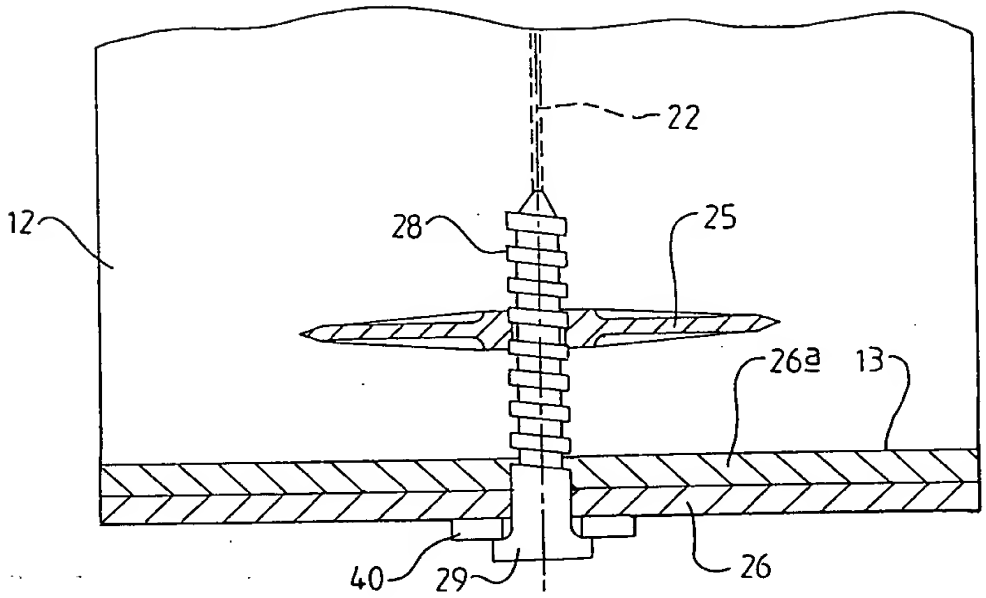
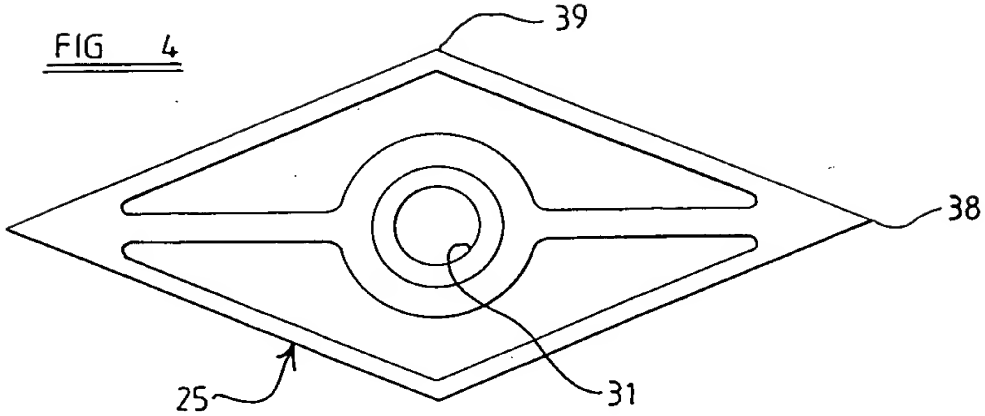


FIG 2

FIG 4



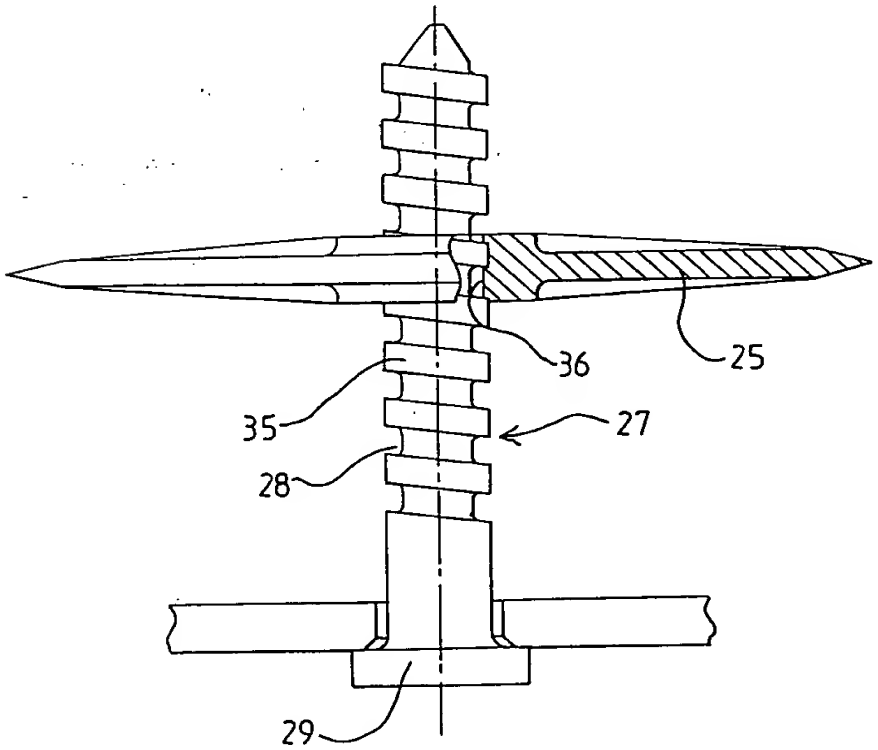


FIG 3

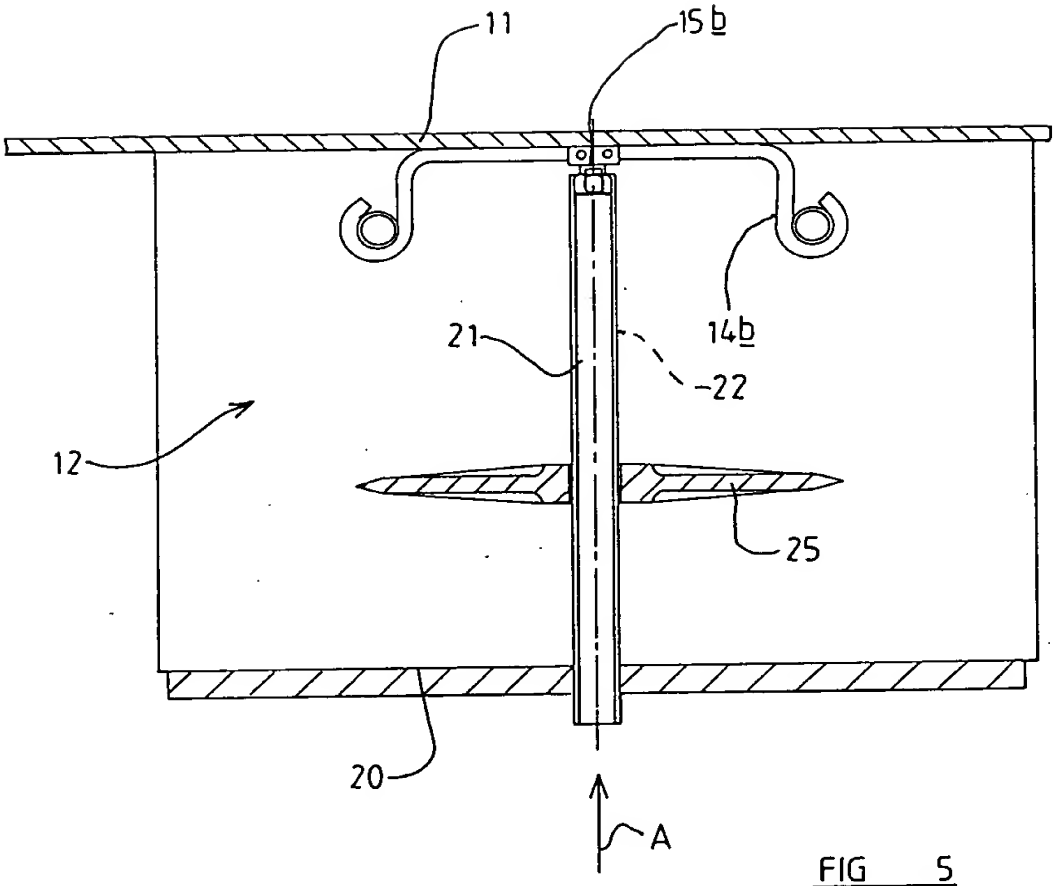


FIG 5

Act No : G[redacted]9 / 01565

Form 23/77 : 7/5/99

AGENT : Forrester Kelley & Co